

4.6. Lake Haines

Background

Physical and chemical characteristics specific to Lake Haines are presented here in the context of relevant regulatory criteria and requirements (Table 4-11). Lake Haines (WBID 1488C), the headwaters of the WHCL Northern Chain, is hydrologically connected to Lake Rochelle via a constructed navigable canal and to Lake Henry via a flow-through wetland (Photo 4-6, Figure 4-21). In 2005, Lake Haines was declared verified impaired based on elevated TSI values (>60), indicating a nutrient impairment. A TMDL is required for Lake Haines to calculate load reductions necessary to satisfy the TSI criteria. The TP, TN, and chlorophyll *a* geometric means for Lake Haines for the period of 1997 to 2007 and corresponding EPA NNC water quality targets are listed in Table 4-11. To comply with the NNC, concentration reductions of 20 percent for TP, 9 percent for TN, and 49 percent for chlorophyll *a* are required.

A summary of water quality statistics for Lake Haines is presented in Table 4-12. In 1992, point source discharges to Lake Haines from the Lake Alfred WWTF were eliminated. These point source discharges resulted in the annual addition of approximately 1,515 kg TP and 2,230 kg TN to the lake. Median chlorophyll *a*, TN and TP concentrations exceed the NNC targets provided by EPA for Lake Haines. Chlorophyll *a* concentrations in Lake Haines have fluctuated but have remained consistently elevated above 20 µg/L (Figure 4-22). A statistically significant decline in chlorophyll *a* concentrations from 1985 to 2007 was observed (seasonal Kendall-Tau, $p=0.009$), indicating improving water quality conditions. Multiple *Hydrilla* eradication projects have been completed in the past several years, with greater than 70 percent of the lake being treated in 2002 and 2003. Beyond the termination of the WWTF discharges in 1992, no water quality improvement projects have been implemented in Lake Haines to restore water quality. Lake Haines is a headwater lake; therefore, improvements in water quality of the lake could result in benefits farther downstream.

The Lake Haines watershed is 4,120 acres in size and includes 767 acres (19 percent) of developed lands compared to 3,353 acres (81 percent) of undeveloped lands. The 2000-2007 median color value (100 PCU) was below 40 PCU indicating the lake is a colored lake. Using the adopted EPA NNC for Florida lakes, characterization of alkalinity or acidity is not necessary based on the colored classification of Lake Haines. The lake area, perimeter, water depth, and volume statistics are based on a water level elevation of 127 feet in October 2006. Bathymetry data are available for Lake Haines for the October 2006 water level elevation (Figure 4-23). A water level of 127 feet was reported in August 2010, indicating a similar water elevation when compared to 2007. Changes in overall surface area, water depth, and volume of the lake should be considered during the development and implementation of water quality restoration projects

Water Quality Restoration Project Selection and Priorities

Based on Lake Haines water quality and the surrounding watershed characteristics, five potential water quality restoration projects were identified using the WHCL WQMP decision key (Figure 4-24). The decision key presents the factors on which yes/no decisions were based and used to identify and select water quality improvement projects. Projects to address water quality, nutrient

Lake-Specific Restoration Projects

and sediment loading, and reduced lake levels are proposed. The projects are listed in order of priority, based on expected water quality improvements. A detailed discussion of the potential water quality restoration implications for each project can be found in Section 3.0.

- Project 1: Stormwater Infiltration Areas (SIAs)
- Project 2: Sediment Removal/Inactivation
- Project 3: Forested Wetland Rehydration
- Project 4: SAV Planting/Management or FTWs
- Project 5: EAV Planting/Management

Table 4-11. Physical, chemical, and regulatory characteristics of Lake Haines.

Physical			
Location in chain	Northern	High infiltration soils (acres)	1,846 (45 percent)
Relation to other lakes	Headwater	Developed land (acres)	767 (19 percent)
Watershed area (acres)	4,120	Undeveloped land (acres)	3,353 (81 percent)
Lake area (acres)*	736	Median water depth (feet)*	7.8
Perimeter (feet)*	30,662	Maximum water depth (feet)*	19.2
Surface area to lake volume ratio*	0.10	Volume (acre-feet)*	7,104
Watershed to surface area ratio*	5.60		
Water Chemistry			
Locally-derived: acidic or alkaline	NA	Clear or colored	Colored
Geometric mean chlorophyll <i>a</i> (ug/L)	39	NNC chlorophyll <i>a</i> target (ug/L)	20
Geometric mean TN (mg/L)	1.35	NNC TN target (mg/L)	1.23
Geometric mean TP (mg/L)	0.063	NNC TP target (mg/L)	0.05
Regulatory Data			
Impaired	Yes	TMDL status	Required
Chlorophyll <i>a</i> trend	Decreasing**	TP concentration reduction required	20 percent

*at a water level elevation of 127 feet

**presented in section 5.0

Photo 4-6. View of northwestern shoreline of Lake Haines.



Table 4-12. Lake Haines water quality summary for 1997 to 2007.

Parameter	N	Minimum	Median	Maximum
Chlorophyll <i>a</i> (µg/L)	269	2.29	50	130
Color (PCU)	53	20	100	280
Conductivity (µmhos/cm)	55	175	218	276
Dissolved oxygen (mg/L)	55	5.47	9.11	12.91
pH	56	6	7.79	9.32
Secchi depth (feet)	266	0.9	1.8	3.6
Total nitrogen (mg/L)	273	0	1.32	2.60
Total phosphorus (mg/L)	267	0.032	0.066	0.144

Figure 4-21. Lake Haines and associated watershed.

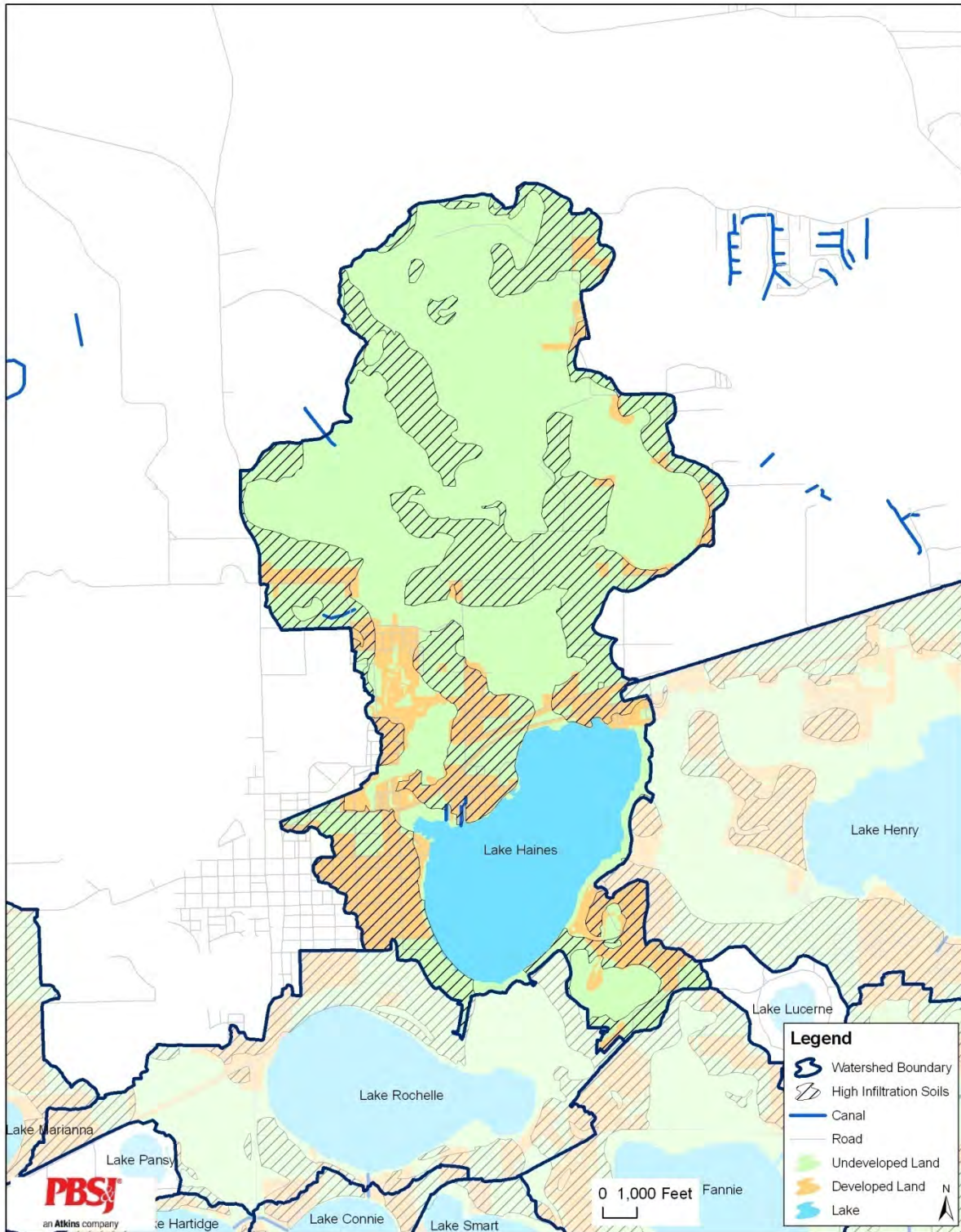


Figure 4-22. Lake Haines chlorophyll *a* concentrations and *Hydrilla* treatment history using available data from 1985 to 2007.

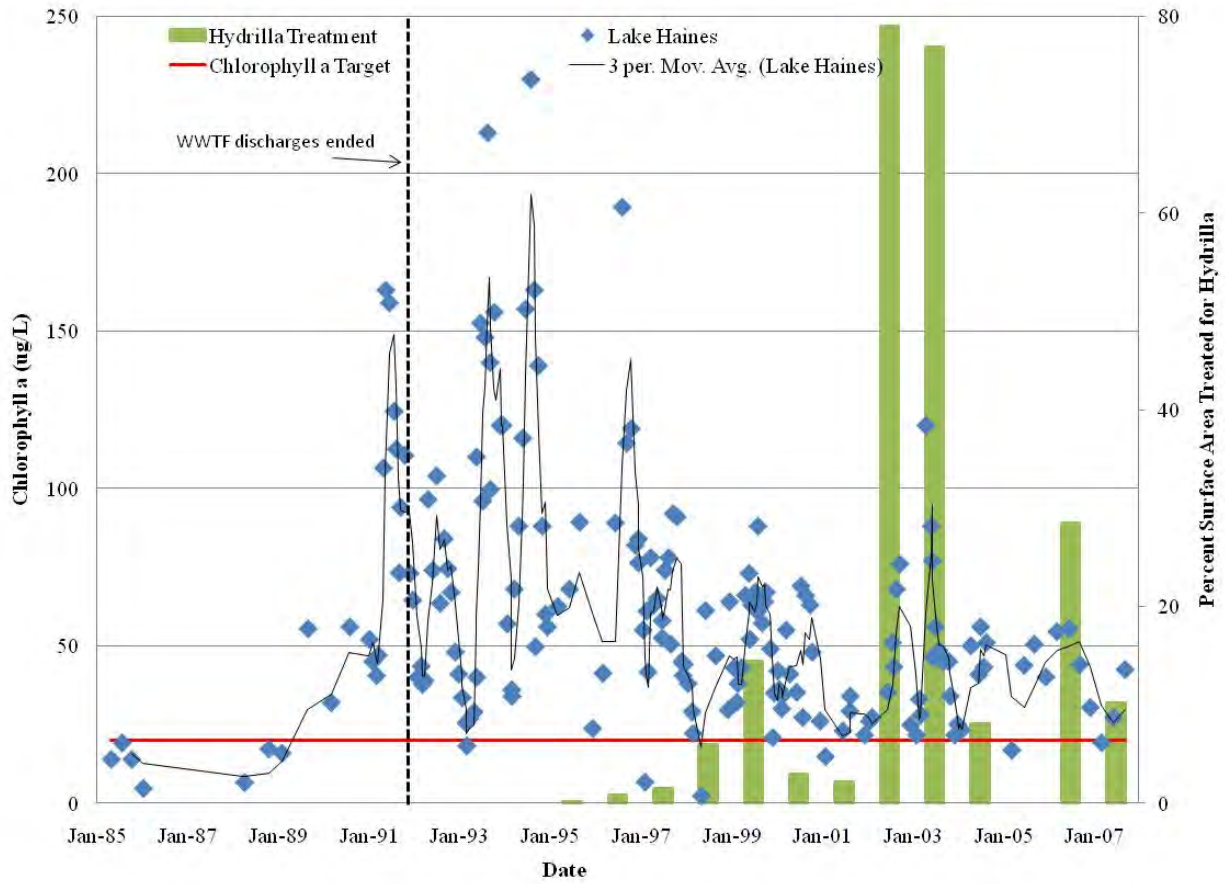
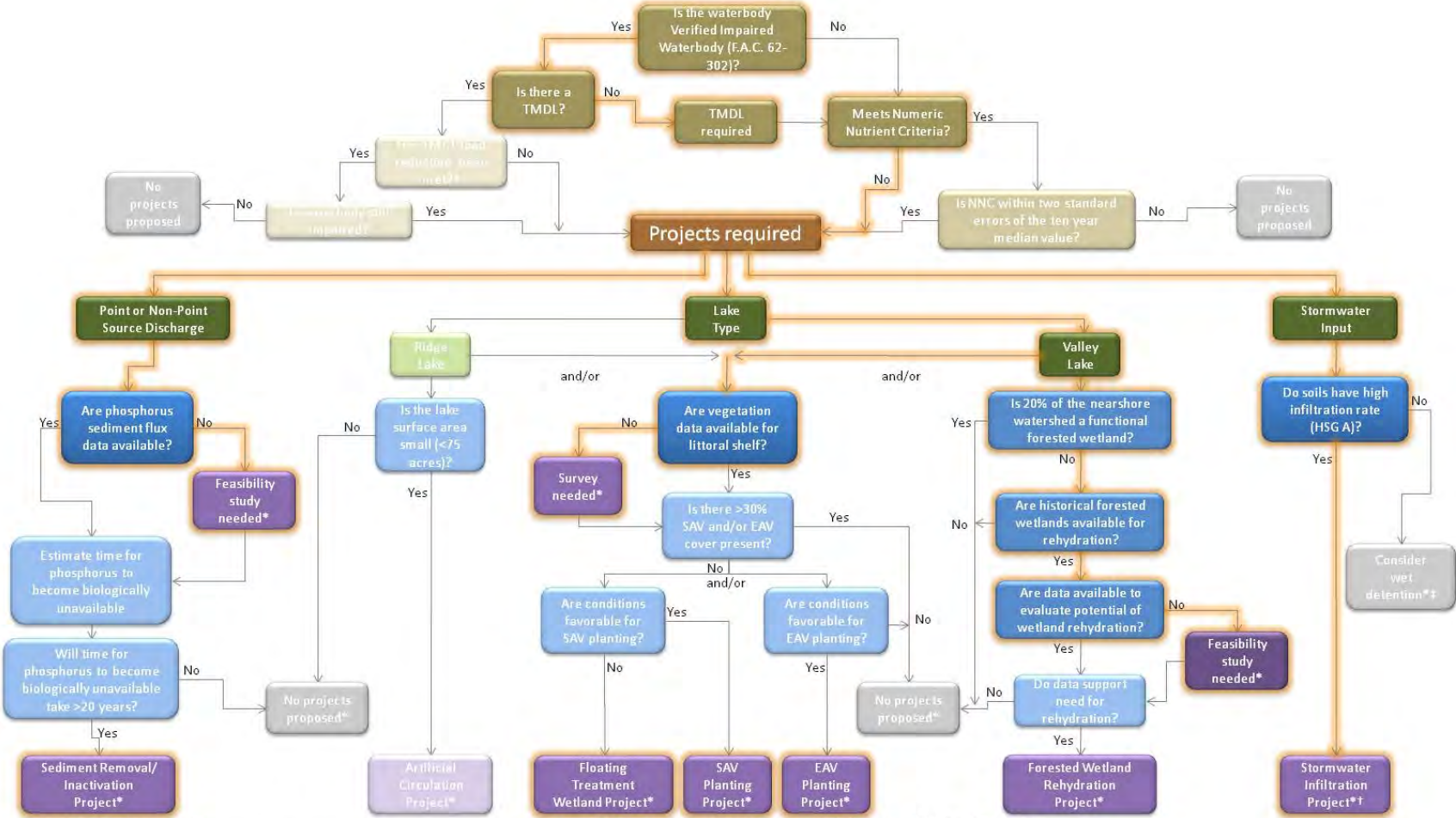


Figure 4-23. Lake Haines bathymetry (October 2006) at water level elevation = 127 feet (Polk County Water Atlas).



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Figure 4-24. Lake Haines decision key: highlighted path shows decision process.



*Consider alternative projects
 ‡Wet detention may also be required if sufficient area is unavailable for dry retention

† Stormwater Infiltration projects could satisfy required TMDL Load reduction

Project 1: Stormwater Infiltration Areas (SIAs)

The Lake Haines watershed has approximately 1,846 acres (45 percent of the watershed) classified as high infiltration soils. The Northern Chain was not included in the PLRG study (USF 2005), therefore a TMDL has not been completed for Lake Haines and data to estimate SIA acres for TP load reduction are not available at this time. SIA implementation could have the additional benefit of increasing storage to supplement dry season lake levels and a reduction in stormwater loads that can be later applied to the required TMDL TP load reduction. As such, SIA design should be focused on recharging the surficial aquifer.

Project 2: Sediment Removal/Inactivation

Historical point source discharges to Lake Haines from the WWTF will require further evaluation of the potential internal phosphorus load from the lake bottom sediments. Presently, sufficient data are not available to evaluate the internal phosphorus load and calculate the phosphorus decay rate and the time at which the phosphorus will ultimately become biologically unavailable in the lake sediments. A feasibility study is required to determine whether sediment removal/inactivation is necessary to reduce internal phosphorus loads to the lake.

Cost Estimate: \$10,000.

Project 3: Forested Wetland Rehydration

Approximately 27 percent of the land cover within the 500 foot buffer surrounding Lake Haines is classified as wetlands using the 2006 FLUCS data. Forested wetlands encompass 17 percent of the total wetland area, which is within the 10 to 20 percent recommended forested wetland cover required to maintain color levels above 50 PCU. While FLUCS classifies the land cover as forested wetland, the hydrologic connection between the lake and adjacent land might not be present as is observed along the southern rim of the Lake.

Three proposed project areas were identified adjacent to Lake Haines expected to rehydrate approximately 235 acres (Figure 4-25). The feasibility study is recommended in order to evaluate the proposed project areas for inundation.

Feasibility study cost estimate: \$100,000.

Figure 4-25. Proposed forested wetland rehydration project areas for Lake Haines.



Project 4: SAV Planting or FTWs

SAV Planting

In Lake Haines, *Hydrilla* eradication in the lake has contributed to the continued degradation in water quality. A survey of existing SAV cover in Lake Haines is recommended due to the lack of sufficient data to calculate percent lake cover. Based on the results of the SAV survey, conclusions regarding SAV planting can be determined. If SAV cover is less than 30 percent, lake conditions should be evaluated to assess if additional SAV is viable based on the soil condition, water clarity and water depth. *Hydrilla* harvesting may be required for successful establishment of selected SAV plants.

SAV plants should not be planted in water depths greater than 2 feet based on the median secchi depth values (1.8 feet). The maximum planting effort could result in vegetation cover of approximately 7 percent of the lake bottom (51 acres). Due to the organic material located in Lake Haines, it is recommended that SAV planting be performed after sediment removal/inactivation, if completed. If sediment removal is completed, the planting area would need to be recalculated using updated bathymetry data.

Cost Estimate: \$240,000 (estimate based on previous purchase and installation cost of \$0.90 per plant provided by EarthBalance®, additional funds included for maintenance).

FTWs

If the feasibility study indicates that more than 30 percent of Lake Haines has SAV cover, FTW may be considered. The installation of floating mats with appropriate aquatic vegetation would be expected to assimilate nutrients from the water column.

Project 5: EAV Planting

A survey of existing shoreline vegetation surrounding Lake Haines is recommended due to the lack of sufficient data at this time. Based on the results of the shoreline survey, conclusions and recommendations regarding emergent aquatic or woody vegetation planting can be determined. If limited shoreline vegetation is present, shoreline conditions should be evaluated to assess if vegetation planting is viable based on the soil conditions, slope, water level and inundation frequency and wave disturbance.